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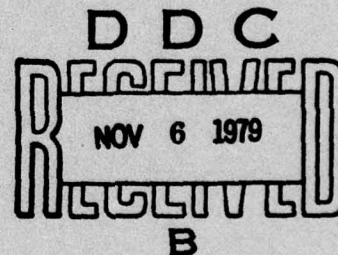
September 1979



# AUTOMATED AIR INFORMATION PRODUCTION SYSTEM, PHASE I Cartographic EBR System

Synectics Corporation

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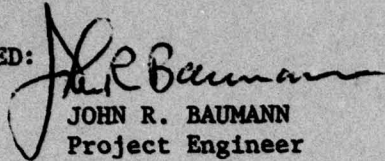
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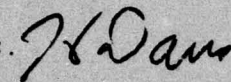
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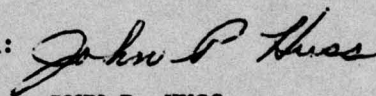
  
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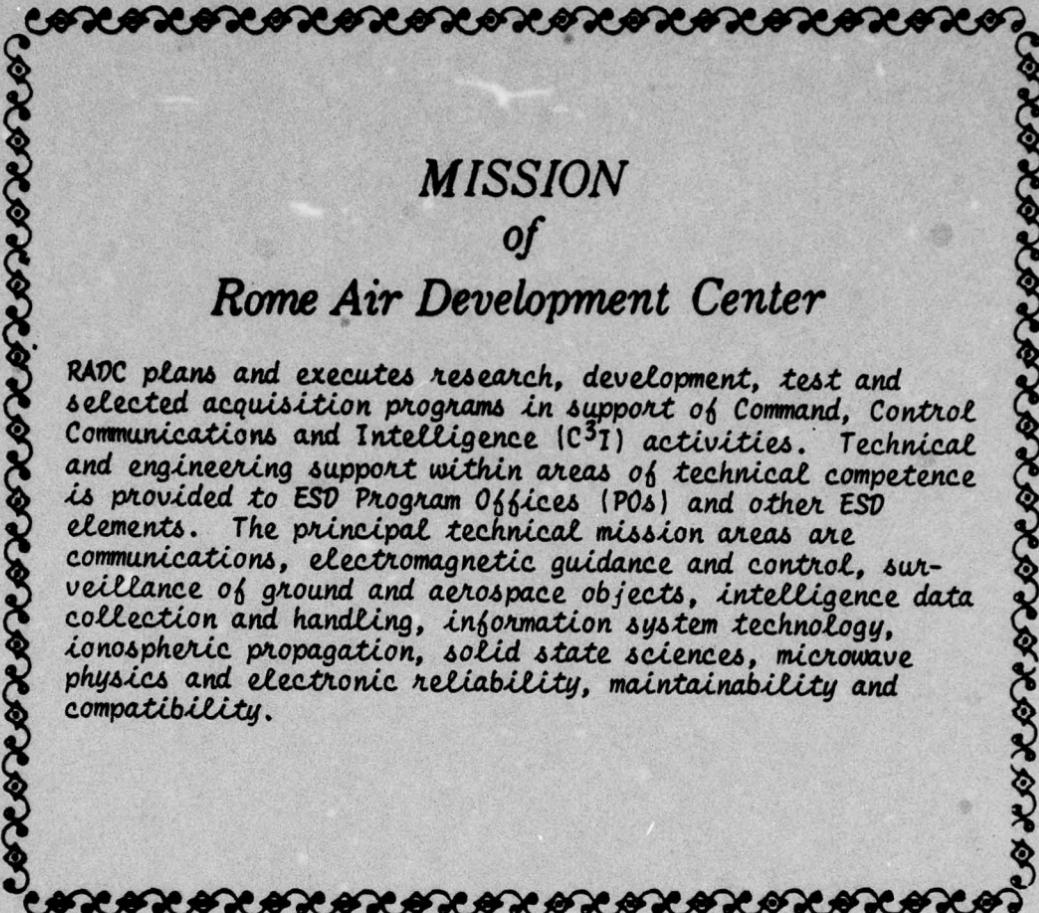
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labor (manual) required for the revision and publication of information critical to flight operations and logistical planning. Improvement of response time between receipt of changes to air navigation/air facilities data and the dissemination of new data to all users, is also provided. The Publishing Subsystem permits publications to be produced on electronic equipment and extends the power and flexibility of digital manipulation to the updating and reformatting of publications. The Air Facilities Subsystem provides maintenance of the AAFIF data bases, selective data base retrieval, special report generation and generation of formatted tape files for film negative output. The Charting Subsystem provides capture, revision and output of graphic data appearing throughout the DMAAC Flight Information Publications, through preservation of data in digital form and providing techniques to simplify alteration of the data.

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## 1.0 Introduction

The Cartographic EBR System delivered in May 1978 to the Defense Mapping Agency Aerospace Center (DMAAC), St. Louis, Missouri by Image Graphics, Inc., (IGI) under Subcontract No. FP-1003-6 with Synectics Corporation (SYNCO), is the principal cartographic output device of the Charting, Publishing and Air Facilities subsystems of the Automated Air Information Production System (AAIPS), as shown in Figure 1-1.

The subcontract reported on herein, was to design, fabricate, install and test an advanced large format, Electron Beam Recorder (EBR) for the production of computer generated master recordings on film, which are subsequently used to produce the following Flight Information Products (FLIP):

- . Enroute High Altitude Charts
- . Enroute Low Altitude Charts
- . Low Altitude Instrument Approach Procedure Books
- . High Altitude Instrument Approach Procedure Books
- . Low Altitude Instrument Departure Procedure Books
- . High Altitude Instrument Departure Procedure Books
- . IFR Supplements
- . VFR Supplements
- . General Planning Books
- . Area Planning Books
- . Area Planning - Special Use Airspace Books

Some examples of Cartographic EBR recordings are shown in Appendix A.

A large format EBR was selected as the cartographic output device because it is ideally suited to consistently achieve the high performance and recording versatility required for this application. Comparative evaluation of the performance capabilities of electron beam, cathode ray and laser recorders clearly indicates that the electron beam recorder is the only computer controllable output device capable of meeting the accuracy, resolution and throughput requirements. The EBR also possess many desirable features which are important in a production environment; such as:

- . Ease of operation
- . Long term reliability
- . Low downtime for repair and maintenance
- . Long term performance stability
- . High degree of flexibility in plotting modes such as vectors, graphic arts, symbols and raster scan gray shading

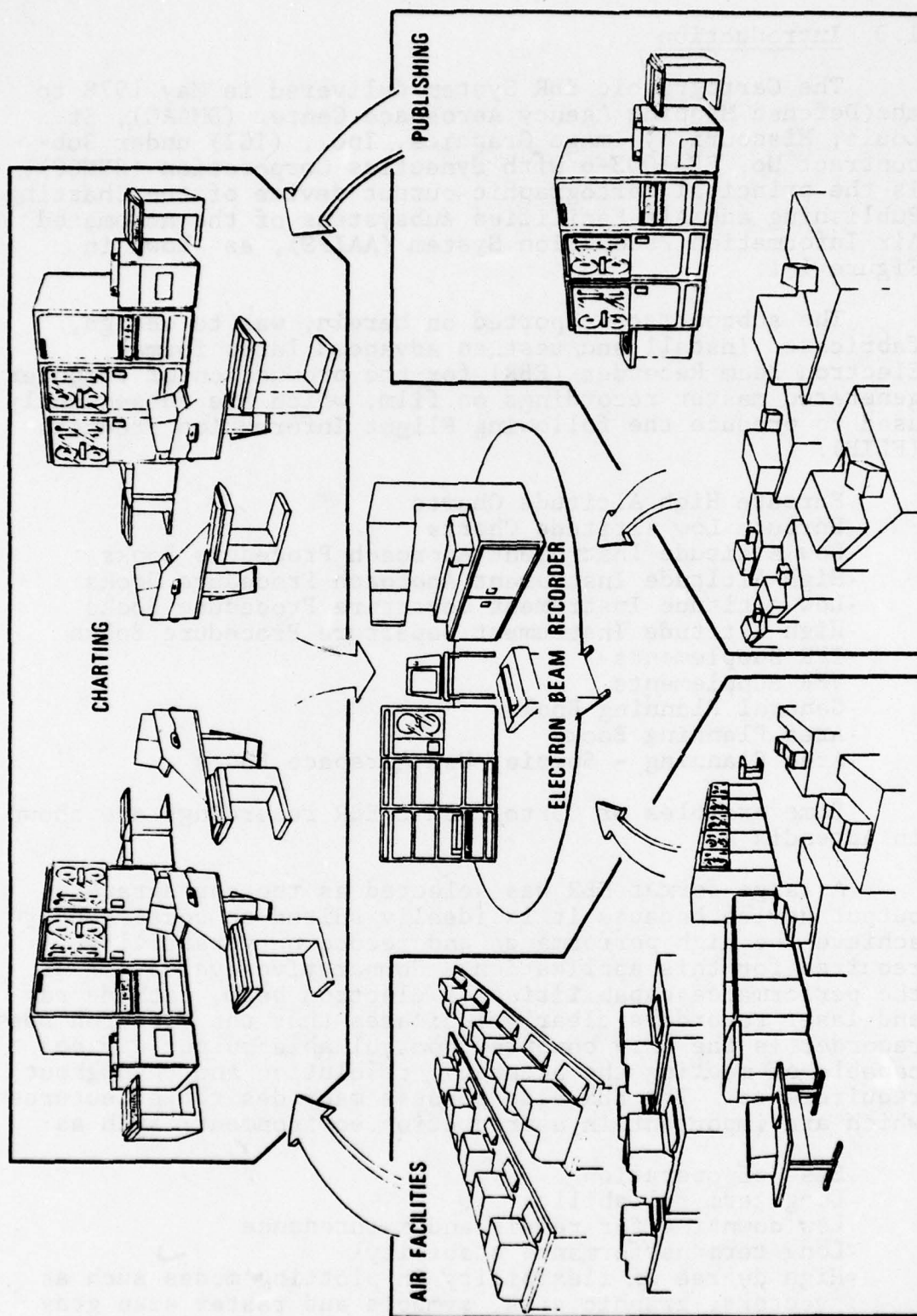



FIGURE 1-1 AUTOMATED AIR INFORMATION PRODUCTION SYSTEM

## 2.0 System Configuration

The AAIPS Cartographic EBR System is a complete stand-alone system, as shown in Figure 2-1 capable of producing hard copy of FLIP products on film at high speed. The Cartographic EBR System normally operates off-line using digital data from magnetic tape input to the system, as illustrated in Figure 2-2 and consists of four functional sub-systems.

Input Section  
Control Section (CPU)  
Data Translator (SVG)  
Recorder Unit



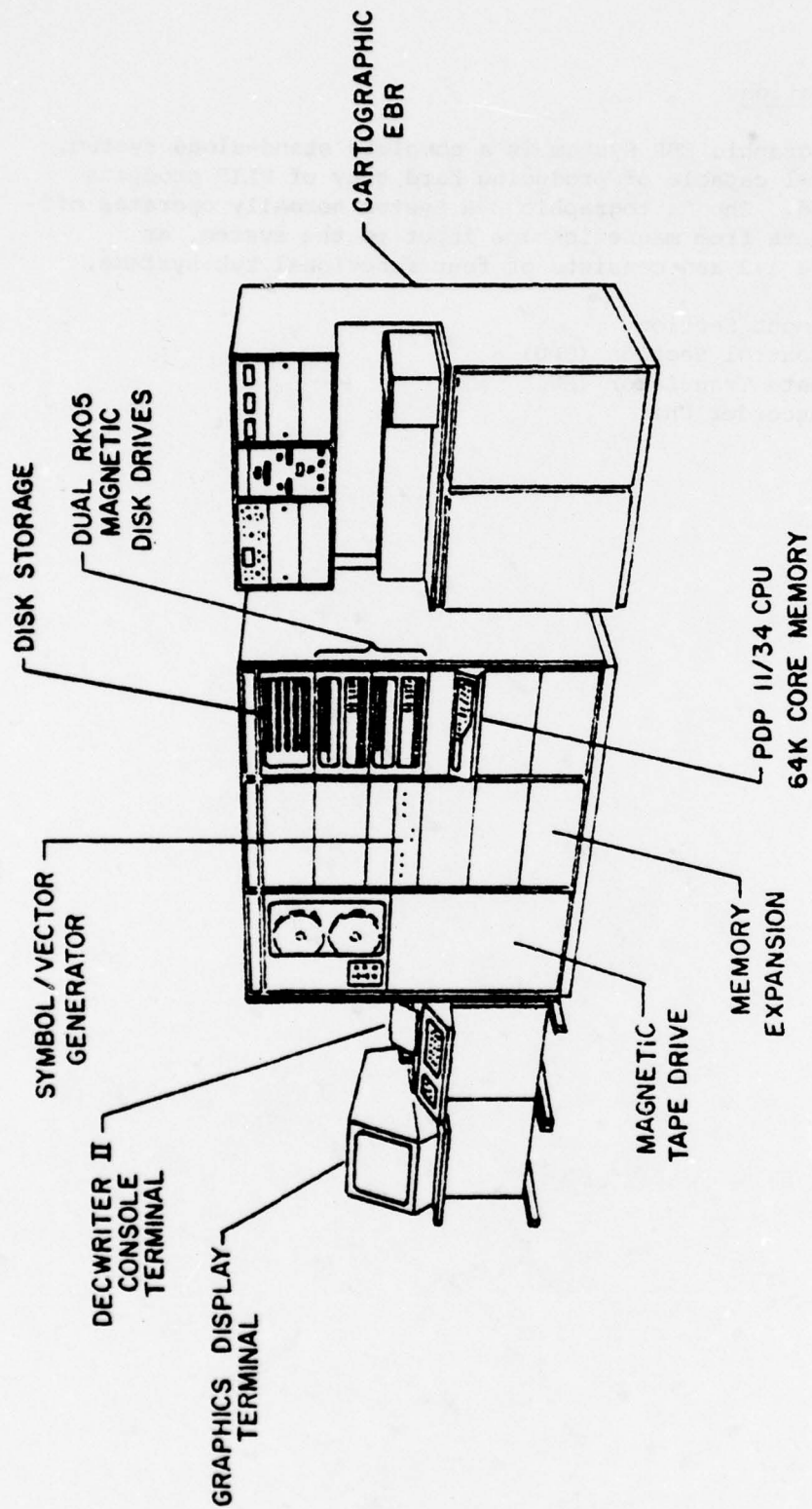


Figure 2-1 Cartographic EBR System Configuration

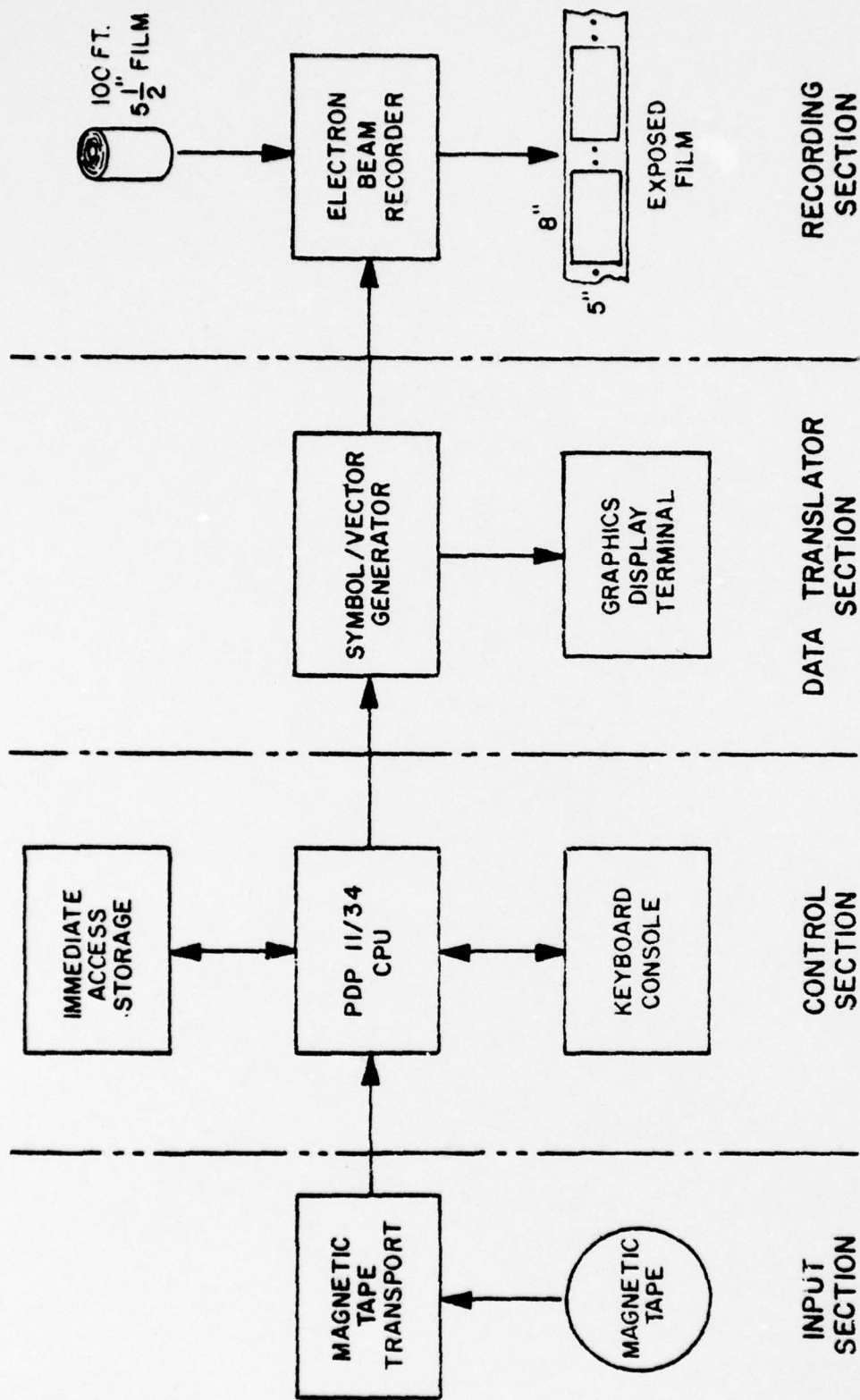


Figure 2-2. General Overview of AAIPS Cartographic EBR System

### 3.0 Computer Controller

#### 3.1 Overall Configuration

The overall Computer Controller, shown in Figure 3-1, consists of Digital Equipment Corporation (DEC) hardware and software; a Tektronix Graphics Display and IGI Control hardware and software.

- PDP11T/34 Central Processor Unit
- 64K of 16 bit read/write parity core memory
- Programmer console
- Automatic power fail detection/restart capability
- 4 level automatic interrupt
- Line frequency clock
- Multi-device automatic bootstrap loader
- Extended instruction set (hardware multiply and divide)
- Memory management
- Current loop (20 ma) serial line interface
- Kit 11D direct memory access interface kit
- DL Asynchronous interface (300 baud line)
- RK11 dual disk drive including two RK0JJ disks
- Peripheral mounting panel
- TE16 tape control and TE16 9 track 800/1600 bpi tape transport
- LA36-CA decwriter II console terminal
- Graphic display terminal (Tektronix Model 619 CRT)
- Operating system software (DEC RSX11M)

#### 3.2 Input Section

The Input Section to the Cartographic EBR consists of a 9 track magnetic tape system and a keyboard console.

The magnetic tape is a TE16 tape control with a TE16 selectable 1800/1600 bpi which accepts industry standard 1/2" magnetic tape and operates at 45 ips. The master tape control can be expanded to operate up to eight tape drives. The keyboard console is a Decwriter II terminal which can be used as an auxillary input/output (I/O) communications link with the CPU.

#### 3.3 Central Processing Unit (CPU) and Memory

The CPU provided is a basic binary processor with 16 bit word and 64K words of core memory. The memory size may be expanded up to 128K words of core. The CPU possesses memory management with address capability of 18 bits; and extended arithmetic capability (hardware multiply and divide) It combines operating data and plotting instructions to the Data Translator (SVG) to generate and position characters, symbols or vectors.

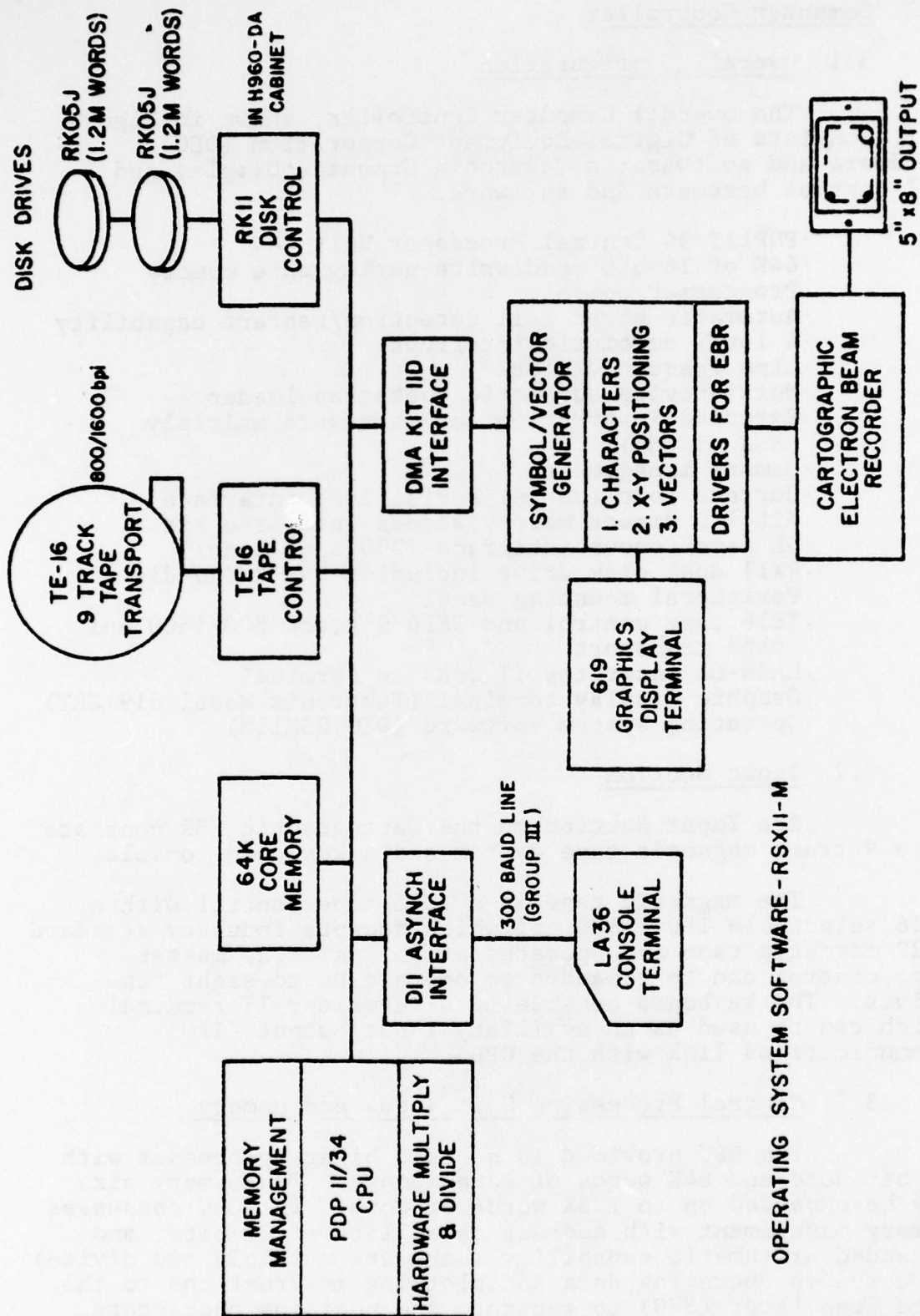


Figure 3-1. AAIPS Cartographic EBR Computer Controller

### 3.4 Mass Data Storage

In addition to the 64K of core memory, the Computer Controller contains two RK05 magnetic disk drives (each with a storage capacity of 1.2M words). One disk is used to store the RSX11M operating software package and the other software programs which control character/symbol and vector generation (i.e. Font Library Update (FLU) and Vector/Symbol Plot (VSP)). The other disk is used to store digital representations of character and symbol fonts. This disk can store up to 40 fonts of 100 characters or symbols.

The RK11 magnetic disk controller can be expanded to control up to eight 1.2M word RK05 disks.

### 3.5 Interfaces

The computer controller is interfaced to the Data Translator via a direct memory access channel (KIT 11D) and to a Decwriter II console terminal through an asynchronous serial interface.

### 3.6 Software

The software packages provided with the Cartographic EBR System are:

- (a) RSX11M-Operating System - DEC
- (b) FLU-Font Library Update - IGI
- (c) VSP-Vector/Symbol Plot - IGI

A brief explanation of each of the IGI supplied software packages is given below:

1) Font Library Update (FLU) - This routine is used to create digital font libraries on disk from properly formatted font tapes. FLU can maintain fonts on disk, i.e. add, delete, display and list symbol data in addition to performing minor editing by changing font data words in memory and writing modified data back to disk.

2) Vector/Symbol Plot (VSP) - This routine controls the plotting of data from an SVG formatted data tape. VSP also has two submodes, listed below:

a) Normal VSP - Allows user to locate specific files and pages of data on data tape, dump selected portions of tape and plot entire or selected portions of tape.

b) De-Bug Mode - Allows interactive plotting via alphanumeric console commands or pre-stored commands which can be placed on disk via the RSX11-M text editor. All SVG input commands can be exercised via the de-bug mode command set.

#### 4.0 Data Translator - Symbol/Vector Generator (SVG)

The Data Translator circuits of the AAIPS EBR System are contained in the Symbol/Vector Generator (SVG), Model 100A. The SVG converts digital data from the computer controller into analog signals which drive the EBR.

The SVG includes all of the circuitry for:

- (a) Character and symbol generation with variable size and orientation control.
- (b) Vector generation in incremental and stroke vector modes with variable line width control.
- (c) Automatic intensity control.
- (d) X - Y random positioning.
- (e) Other controls and interfaces for the EBR.

All scaling of character and symbol sizes and positioning of characters with the proper orientation and exposure level; all line work and map features with the proper line width, orientation and exposure level; and all random positioning, is accomplished with the SVG.

## 5.0 Graphic Display Terminal

A Graphics Display Terminal has been provided to allow viewing of the data being plotted by the EBR during the recording process.

The display is a Tektronix 619 storage display which is interfaced directly to the SVG via an analog adapter interface.

## 6.0 Electron Beam Recorder

### 6.1 General Description

An Electron Beam Recorder (EBR) is an instrument which converts electrical signals representative of map features, alphanumeric characters, graphic plots or variable density pictures into latent images on electron sensitive film. The latent image is formed by exposing the film with a precisely controlled, finely focused electron beam. An EBR may be regarded as analogous to a cathode ray tube (CRT) recorder where the lens and the phosphor faceplate have been removed and the recording medium placed in the vacuum.

An IGI, Series 2000 EBR, is shown schematically in Figure 6-1. It consists of a high resolution electron gun, an electromagnetic system for focusing, deflecting and controlling the electron beam, a film transport mechanism for handling various film media, a fully automatic vacuum system which maintains suitable vacuum in various parts of the recorder and a number of highly regulated power supplies, electronic circuits, and monitors. Operation control functions of the EBR 2000 have been kept to a minimum and are readily accessible to provide the operator with convenient control and ease of operation. Modular construction provides ease of maintenance, trouble-shooting and repair.

Some of the system components within the EBR cabinet used for the AAIPS Cartographic EBR System are shown in Figures 6-2 through 6-6.

Various recording media may be used in Electron Beam Recorders; (a) high resolution fine grain silver halide electron sensitive film which is processed by conventional wet chemistry after exposure to electrons; (b) dry silver which forms visible images by heat processing after exposure; (c) direct recording film which forms images directly on exposure to electrons and requires no processing whatsoever; (d) electro-static films and papers which are processed with toner solutions; and (e) electron resists which can be developed by conventional means.

The recording film selected for the AAIPS Cartographic EBR is Kodak Direct Electron Recording Film, Type SO-219.

### 6.2 Vacuum System

The vacuum system of the AAIPS Cartographic EBR, is a high performance, fully automatic, three stage, differentially pumped system which ensures that proper vacuum is maintained in every section of the EBR.

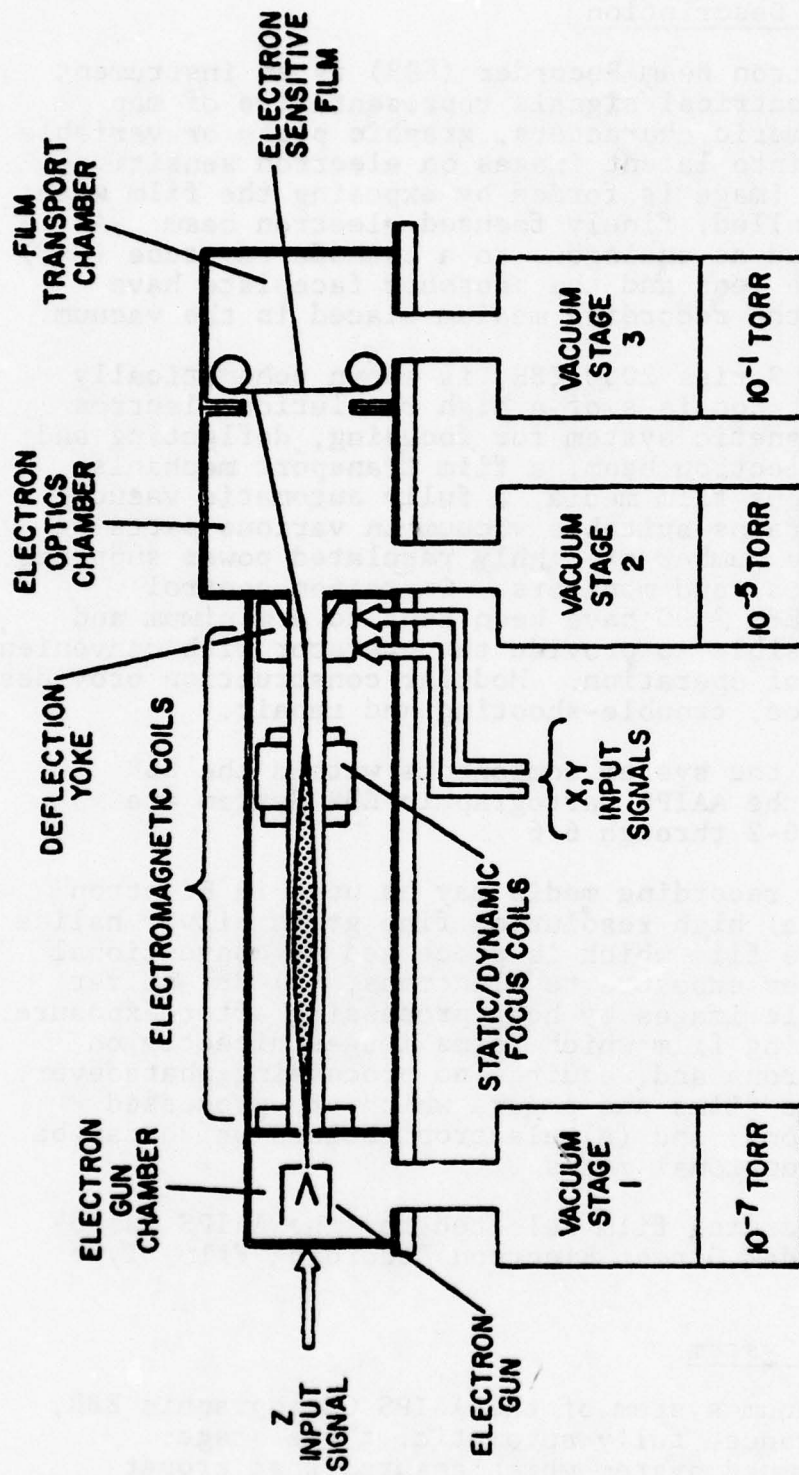


Figure 6-1. Schematic Layout of Cartographic EBR

Since the EBR vacuum system is fully automatic, no prior vacuum technical background or experience is required to operate the EBR. The operation of the entire vacuum system, once power has been turned on, is controlled by two pushbuttons on the EBR Operation Control Panel. As operational vacuum is attained in each of the three principal sections of the EBR, vacuum status is displayed on the EBR Operation Control Panel by indicator lamps.

The warm-up time for the vacuum system of the AAIPS Cartographic EBR, from a cold start to operational vacuum, is less than one hour. The pump-down time with a full supply of film is less than 5 minutes. The pumping capacity is sufficient to handle the outgassing of 400 cm<sup>2</sup> of film per minute. Typically, the Electron Gun Chamber is operated at 10<sup>-7</sup> Torr, the Electron Optics chamber at 10<sup>-4</sup> Torr and the Film Chamber at 100 millitorr.

#### 6.2.1 Diffusion Pumps

The vacuum system of the Cartographic EBR uses two 3-inch, 300 litres/second diffusion pumps, provided with special fans to minimize the 60 Hz magnetic fields generated by the fan motors. These diffusion pumps have very low oil back-streaming rates and in addition, have been provided with optically dense, high conductance baffles to minimize oil contamination problems. The baffle for the diffusion pump connected to the Gun Chamber is cooled thermoelectrically.

### 6.2.2 Mechanical Pumps

Three direct drive mechanical pumps are used in the vacuum pumping system of the Cartographic EBR. Two of these pumps, having a displacement of 2.2 and 10.3 CFM, are used as backing pumps for the diffusion pumps, whereas the third pump, with a displacement of 14.5 CFM, is connected directly to the Film Chamber.

The following features of the mechanical vacuum pumps are significant for electron beam recorders:

- High Efficiency
- Direct Drive
- Two-Stage Construction
- Oil-Sealed
- Anti-Suckback Design
- Built-in Safety Valve
- High Water Vapor Tolerance
- Vented Exhaust
- Compact
- Low Weight
- Quiet Operation
- Modular Construction, for easy servicing in the field

### 6.2.3 Vacuum Gauges

The vacuum system of the Cartographic EBR includes seven high performance vacuum gauges. The two cold cathode discharge gauges (Varian 860, with set-point controls in the  $10^{-5}$  to  $10^{-7}$  Torr range) have been specially modified to operate with Alcatel CF2P vacuum sensors. Alcatel vacuum sensors are used in the EBR, in preference to Varian sensors, because they have lower external magnetic fields and consequently do not affect the electro-optical alignment of the EBR.

The other five vacuum gauges used in Cartographic EBR are of the thermocouple type, operating in the 2 Torr to  $10^{-3}$  Torr range. Two of these (Varian 801) indicate the foreline pressure of the diffusion pumps, whereas the other three (Varian 810) are provided with set-point controls and are used in the automatic control of various vacuum valves in the EBR.

### 6.2.4 Fail-Safe Features

The automatic sequencing of the operation of all the vacuum valves is very simple and fail-safe. It is controlled by the output of the vacuum gauges which measure the actual vacuum in every section of the EBR and is not controlled by time delays.

The single vent valve is normally closed and has to be energized to open. Consequently, in the event of a power failure, the EBR vacuum system will not be vented and the hot diffusion pump fluid will not be exposed to oxidation of the atmosphere.

Since the mechanical pumps are provided with built-in safety valves, the vacuum system of the EBR will remain totally sealed and undamaged, should an accidental power failure occur.

### 6.3.1 Electron Gun

The electron gun used in the Cartographic EBR, is a triode of unique and proprietary design with a directly heated thermionic emitter. It incorporates many of the latest improvements which have been introduced in the design of electron guns for transmission electron microscopes, micro-probe analyzers, scanning electron microscopes, as well as for electron beam recorders.

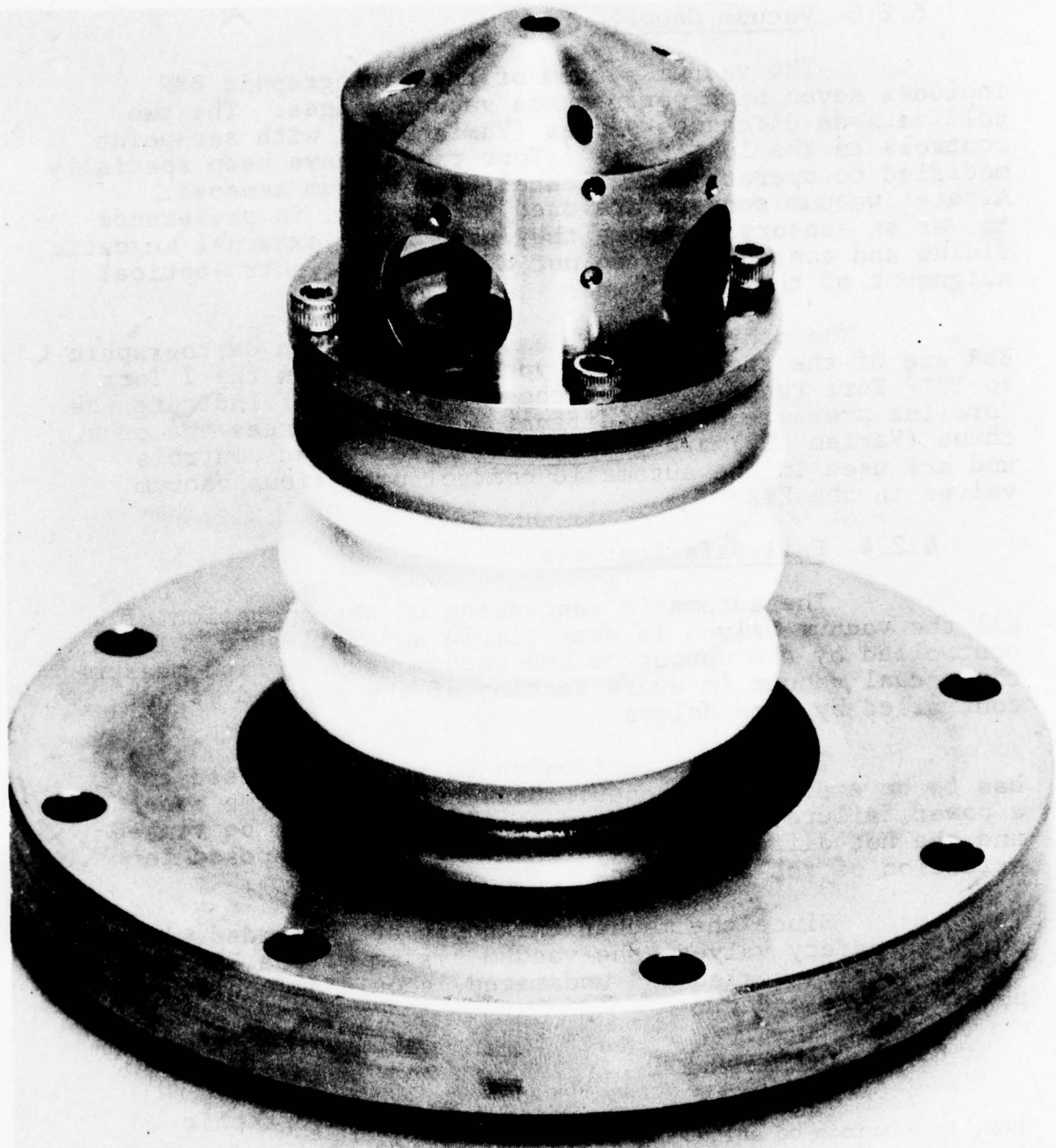


FIGURE 6-2 ELECTRON GUN

The aperture in the grid cup (Wehnelt cylinder) of the electron gun is small resulting in a less divergent beam and consequently in improved resolution. The grid cup is provided with precise adjustments for accurately centering the cathode.

The cathode (directly heated thermionic emitter) of the electron gun is a TYPE AR filament used for applications where the ultimate stability is demanded and long operating life is important. It features a gradated loop configuration and a unique tip geometry to optimize heat transfer characteristics.

AR filaments (cathodes) are mounted on ultra stable ceramic bases (not glass, mica or plastic), have extra short support posts, and are made of a tungsten-rhenium alloy (not pure tungsten) to ensure ultimate performance and a MTBF of thousands of hours, provided that they are operated in an adequately high vacuum.

The anode structure of the Cartographic EBR electron gun is designed to accept commercially available platinum apertures used in electron microscopes. The anode aperture is mounted on a ceramic spacer and is therefore, electrically isolated from the gun chamber. Consequently, the anode current in the Cartographic EBR can be separately measured and controlled. The feature is essential for all random plotting EBR applications.

#### 6.3.2 Electron Optic Coils

The arrangement of electron optic coils used in the Cartographic EBR, is shown in Figure 6-4.

The electron optic coils consist of an alignment yoke for positioning the beam through the center of a high resolution static and dynamic focus coil which focuses the beam of electrons into a concentrated round spot approximately 5 microns in diameter; an astigmatism corrector for removing residual spot distortion caused by any magnetic asymmetry in the focus coil; a high performance deflection yoke which is capable of positioning the electron spot across the format without introducing any appreciable spot distortion or spot growth; and a spot wobbler yoke to provide automatic line width control during plotting. The entire electron optic column is surrounded by a magnetic shield to prevent interference and interaction of stray magnetic fields with the electron beam.

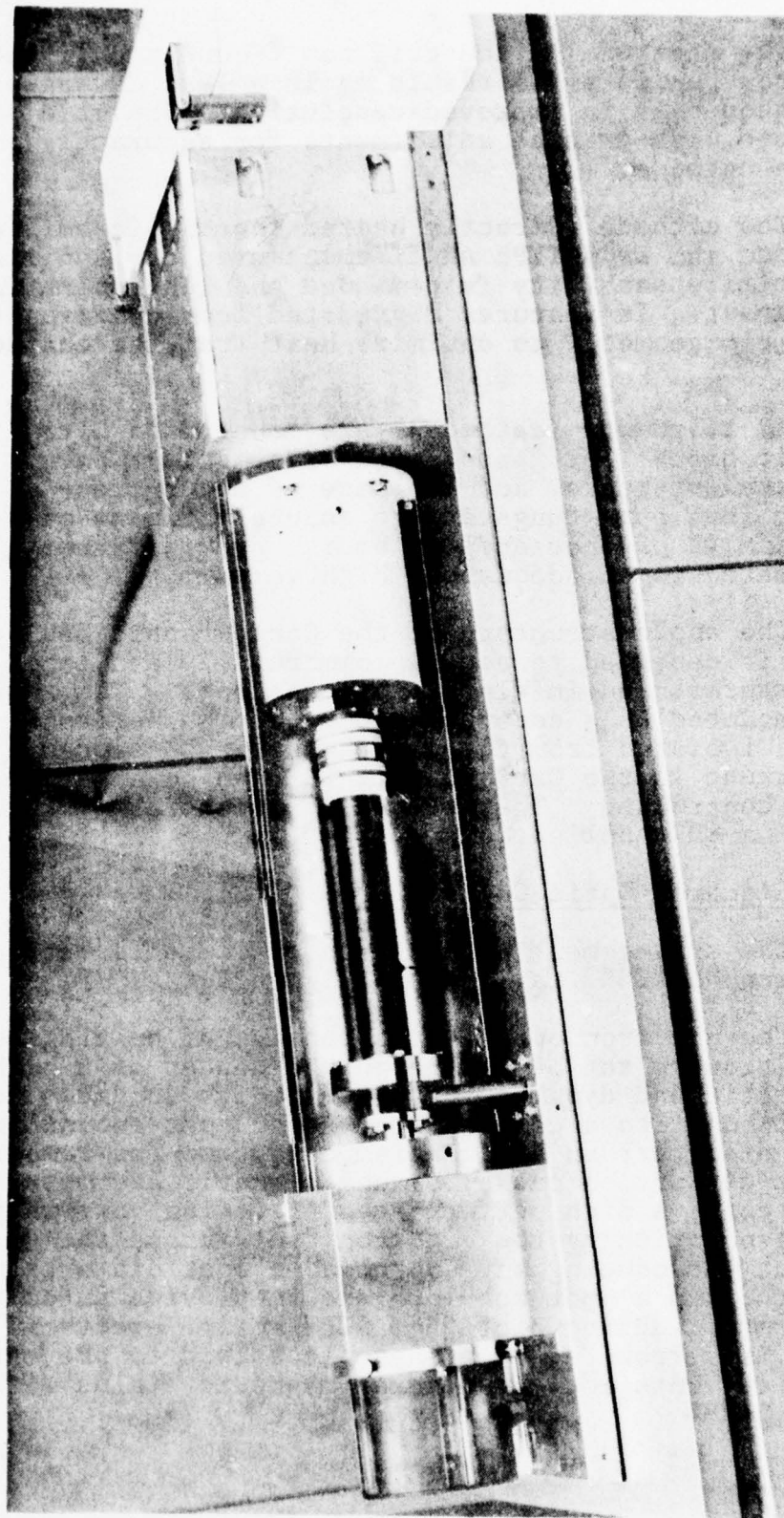


Figure 6-3 Electron Optics Column

Since geometrical image errors such as pin-cushioning are corrected electronically in the Cartographic EBR, no geometric correction coils or magnets are used. The deflection yoke has sufficiently low inductance for high speed subraster generation of graphic arts characters so that a separate subraster yoke and deflection system are not required.

#### 6.3.2.1 Beam Alignment Yoke

A beam alignment yoke is used to position the electron beam precisely along the electro-optical axis of the EBR. It features a unique coil design which results in uniform characteristics in both alignment axes and a low residual magnetism core.

The beam alignment yoke is mounted immediately in front of the anode aperture, thus minimizing the geometric image distortions which might occur if the electron gun is not perfectly aligned.

#### 6.3.2.2 Static and Dynamic Focus Coil

A single gap static and dynamic focus coil assembly is used in the Cartographic EBR. The electron beam is focused at the center of the recording format by a very stable constant current through the main or "static" winding of the focus coil. Appropriate currents are applied to the "dynamic" winding of the focus coil to dynamically refocus the recording spot as it is deflected toward the edges or corners of the format.

The focus coil is mounted in the EBR sufficiently far away from the deflection yoke to eliminate spot distortions caused by the interaction of the magnetic fields of these components.

#### 6.3.2.3 Astigmatism Corrector

An astigmatism corrector is used to compensate for the residual astigmatism of the focus coil. Basically, such a corrector consists of two sets of coils wound on a common annular core.

In order not to produce a component of deflection, the Cartographic EBR astigmator corrector is attached directly to the main electro-optic components housing so as to be precisely centered on the electro-optical axis.

#### 6.3.2.4 Deflection Yoke

The deflection yoke produces the magnetic fields which precisely position the electron beam across the entire recording format. The deflection yoke for the Cartographic EBR uses a low loss, ground, ferrite core proportioned to provide an anastigmatic field and to eliminate higher order beam distortions. A unique coil winding configuration provides complete symmetry between deflection axes. Typical focus variations caused by the end turns of saddle or stator yokes have been eliminated. Consequently, using dynamic focus modulation, uniform focus over the complete recording format can be achieved. The deflection yoke winding method provides precise placement of coil turns so as to minimize geometric distortions.

#### 6.3.2.5 Spot Wobble Yoke

A low inductance, air core, Spot Wobble Yoke is mounted concentrically on the precision ground glass tube between the Beam Alignment Yoke and the Astigmatic Corrector, but much closer to the later.

A 10 MHz signal of variable amplitude is applied to the Spot Wobbler Yoke in order to control the effective size of the recording electron beam, thus making it possible to record lines of variable widths.

#### 6.3.3 Magnetic Shields

The entire electron beam path, from electron gun to recording film, is thoroughly shielded from the interference of magnetic fields emanating from other nearby components, by a two-layer magnetic shield made of high permeability material. This reduces unwanted beam displacements due the EMI (particularly at 60 Hz) to less than a micrometer.

#### 6.4 Film Transport

The 5½ inch film transport, which is installed in the AAIPS Cartographic EBR is of unique and proprietary design and is shown in Figure 6-5 it has a recording aperture of 8-9/32 x 5-1/32 inches which is adequate for recording standard Instrument Approach and Departure Charts at full scale. This transport features a curved film gate and constant film tension which ensure a consistent and repeatable positioning of the recording film. Advance, for the non-perforated film, is metered to a constant length of 10 inches.

IGI Proprietary 5½ Inch Film Transport

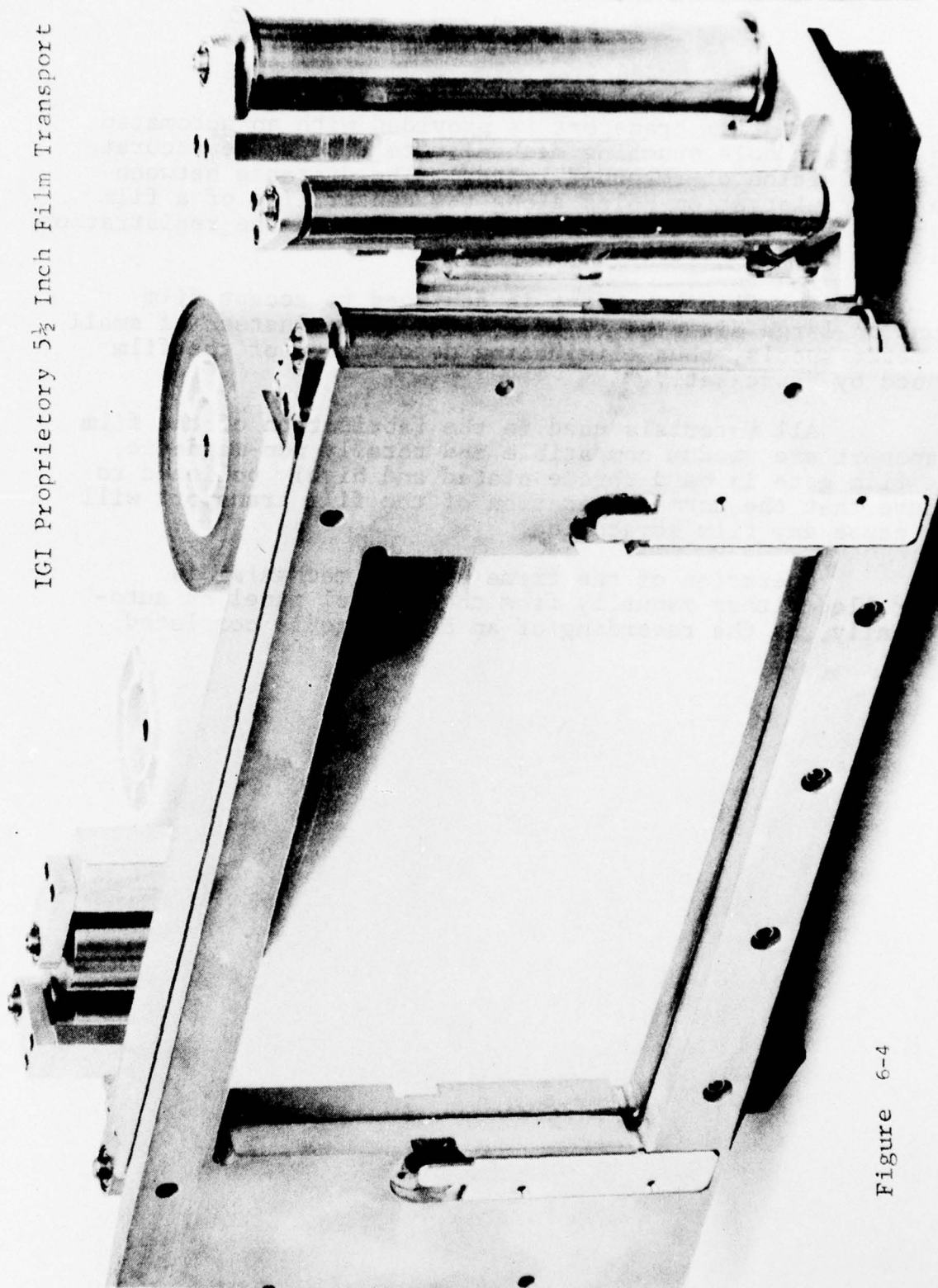


Figure 6-4

The film transport is provided with an automated registration hole punching mechanism to ensure the accurate superimposition of recorded images. The distance between the two registration holes along the center line of a film frame is exactly 9 inches and the diameter of the registration holes is  $0.2500 \pm .0002$  inch.

The film transport is designed to accept film wound on large diameter (2 or 3 inch) cores instead of small diameter spools, thus eliminating deformation of the film caused by "core-set."

All materials used in the fabrication of the film transport are vacuum compatible and totally non-magnetic. The film gate is hard chrome plated and highly polished to ensure that the normal operation of the film transport will not cause any film scratching.

Operation of the frame advance mechanism is controlled either manually from the control panel or automatically, as the recording of an EBR image is completed.

## 7.0 Cartographic EBR System Performance

Numerous recordings made on 5½" wide film (5" x 8" format) over a period of several months indicate that the performance levels shown in Table I, can be achieved or exceeded on a routine basis.

TABLE I

TYPICAL CARTOGRAPHIC EBR SYSTEM PERFORMANCE CHARACTERISTICS

Film Type	Kodak SO-219 unperforated
Film Size	5-1/2" wide
Film Capacity	100 Feet wound on 3" diameter cores, emulsion side out
Film Transport	Single/frame pull down with registration punches
Registration Holes	Two 1/4" holes, 9 inches bounding each frame
Film Pull Down	5 secs
Minimum Line Width	6 um
Variable Line Widths (EBR Image Scale)	6 to 261 um with 8 bit (256 levels) control, in 1 um increments
Character Sizes (EBR image scale)	8-250 mils
Character Rotation	1° Increments
Beam Position	19,859 x 32,768 address matrix over a 5" x 8-1/4" format area
Congruity of sequential images	+ .003% of full size of image
Geometric Fidelity	+ .01% (with software correction) ± .05% (without software correction)
Maximum optical density	2.35+
Line density range (gray shades, discernible steps)	64
Background density	0.1 density unit
Video Bandwidth	DC - 10 MHz
Writing Speeds	
Random Points*	40K points/sec
Adjacent Points (IVP)	120K points/sec**
Stroke Vectors	10K points/sec
Character Generation Speeds	1K
(Character per second at EBR scale)	
8-250 mils (Graphic Arts) characters/sec (AVG)***	

TABLE I  
(Con't)

- \* With 1600 bpi input tapes having maximum blocking factors and not requiring data validation and parameter adjustments.
- \*\* SVG Hardware capable of 125,000 points/sec.
- \*\*\* SVG Hardware capable of generating up to 2,000 character/sec. depending upon character style and size.

## 8.0 Conclusions

The Cartographic EBR System developed by Image Graphics, Inc., under this subcontract meets or exceeds the performance requirements for the automated production of high quality AAIPS Flight Information Products. The high throughput and versatility of the EBR System will ensure the achievement of future chart production at minimum equipment cost.

## 9.0 Recommendations

1. The Cartographic EBR System may be expanded to record other types of aerospace imagery, such as high resolution aerial or satellite reconnaissance photographs.

2. The Cartographic EBR System may be expanded to record other image formats using 35, 70 or 105 mm wide film for a variety of micrographics applications.

3. Investigations should be conducted to determine the feasibility of recording a matrix of microimages (i.e. 16,32 and 64 up) for Instrument Approach and Departure Charts and then using optical enlargement to full scale. This would greatly increase production throughput over the present method of recording this chart at 1:1 magnification.

4. The use of a special text recording mode incorporated in the Cartographic EBR System for producing various books and manuals should be investigated. The present character/symbol generators and associated software are designed primarily for charts and maps where random positioning, scaling and rotation of characters and symbols are important. This technique necessitates the use of extensive software overhead which reduces the character and symbol recording rate. In typesetting for books and manuals data, character placement, size and orientation are predictable and therefore could be accomplished with a much lower software overhead and consequently recorded at much higher speed.

5. Since the Cartographic EBR System will be operating in a production environment and is the only output device for the three major subsystems of the AAIPS facility, it is strongly recommended that a back-up system be procured for current and future pilot production requirements.

6. The advantages of using a higher capacity vacuum system should be investigated. The present EBR vacuum allows about 60 frames/hour. This could readily be doubled or even quadrupled without major design changes.

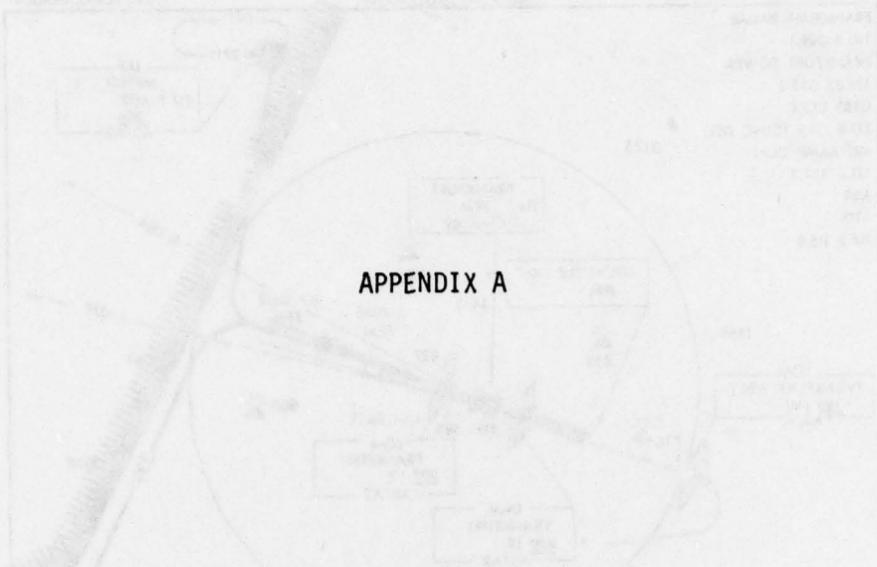
7. The expansion of the DEC computer controller with additional memory and peripheral would allow maximum utilization of the RSX11M Multi-task software operating system.

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APPENDIX A

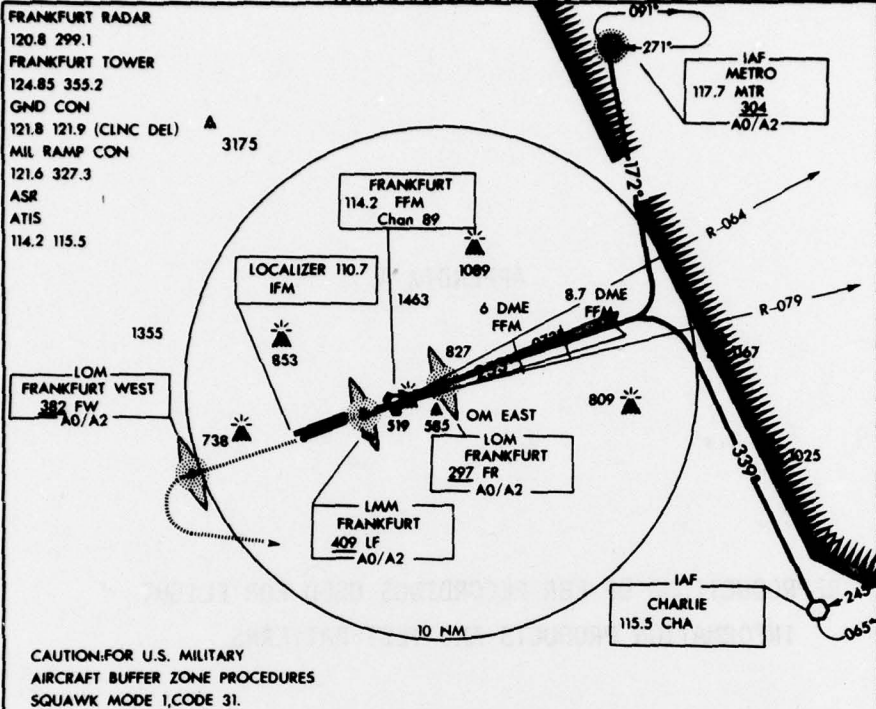
REPRODUCTIONS OF EBR RECORDINGS USED FOR FLIGHT  
INFORMATION PRODUCTS AND TEST PATTERNS

# ILS RWY 25L

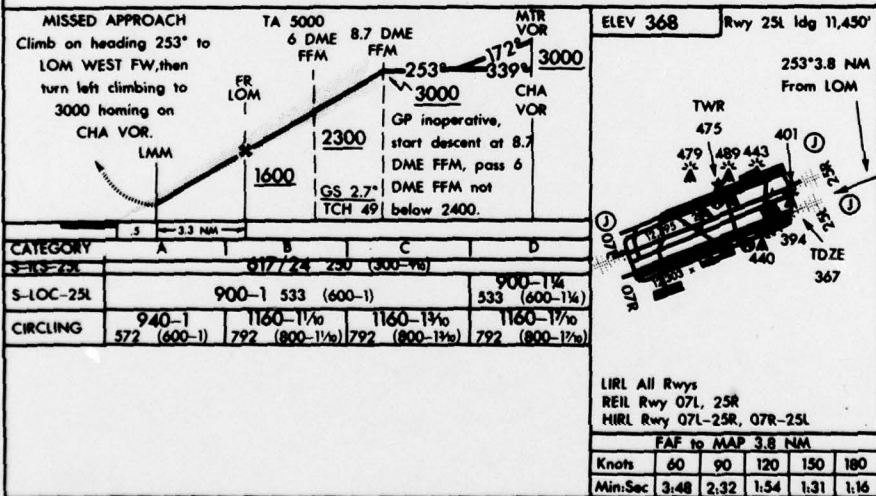
(USAF)AL-1736(GERMANY)

FRANKFURT MAIN (EDAF)

FRANKFURT, GERMANY



MIN SAFE ALT 25 NM 4200



# ILS RWY 25L

50°02'N - 08°34'E

FRANKFURT, GERMANY

FRANKFURT MAIN (EDAF)

8 10/30/78 16: 6

## AERODROME/FACILITY DIRECTORY 31

**CHEHL DOKTOR, IRAN 36°42'N 55°11'E GMT+3:30(+4:30DT) L-17B**  
CIV 5217 47 (GRAVEL)

**CHEHL DOKTOR ARMY CAMP, IRAN 36°43'N 55°18'E GMT+3:30(+4:30DT) L-17B**  
IIA 5256 23 (EARTH)

**CHEKKA, LEBANON 34°18'N 35°42'E H-13A, L-16F**  
VORW CAK 116.2 198° 30.0 NM to Beirut Intl.  
VOR unuse 040°-190° byd 20 NM blw  
12,500'

△ ◇ **CHERBOURG/MAUPERTUS, FRANCE 49°39'N 01°28'W (AOE) GMT+1(+2DT)**  
CIV 456 \*B14, 7 H80 (CON) (S110, T136, ST172, TT246) **H-3B-6E, L-7B**  
FUEL①-(NC-CIAITA2) (LFRC)  
**AERODROME REMARKS**-Opr 0700-2200Z for sked acft. Ldg fees rqr. ①0700-1700Z OT til 2111Z  
O/R prior 1600Z. Sun and hol O/R previous day prior 1600Z.

### COMMUNICATIONS

CHERBOURG APP CON-127.3 To FL 100.

CHERBOURG ARPT Tower-124.7 (V)

### RADIO AIDS TO NAVIGATION

TACAN CBG Chan 72 (100/25) 49°37'13"N 01°17'49"W 294° 7.2 NM to Fld.

DB(10 NM-W) (A1) MP 373 49°38'N 01°22'W 288° 3.2 NM to Fld.

VHF/DF CHERBOURG HOMER-127.3 121.1

ILS-Unuse sctr 120°. GS on test.

**CHERCHELL, ALGERIA 36°37'N 02°12'E H-4F-9C, L-13D**  
NDB (50 NM-W) (AO/A2) CHE 397. O/S UFN.

**CING MARS LA PILE ATCC, FRANCE (FAF)**  
RAKI RADAR-(See FRANCE ATCC FAF)

**CIRCEO, ITALY 41°15'02"N 13°07'04"E H-7D, L-12E**  
NDB (50 NM-W) (A1) CIR 366

**CLACTON, ENGLAND 51°50'54"N 01°08'59"E H-3B-6E, L-4H**  
VORW-DME CLN 115.7 Chan 104 (100/50) 041° 17.0 NM to Woodbridge. DME MP 1230-1630Z 3rd  
Wed.

△ **CLERMONT FERRAND/AULNAT, FRANCE 45°47'N 03°10'E (AOE) GMT+1(+2DT)**  
CIV 1089 L4, 6, 7, 9, 11 H99① (ASP) (S123, T145, ST175, TT233) **H-3C-4F-7B, L-8G**  
FUEL-(NC-AITA2TB) OX (LFCL)  
A-GEAR②  
RWY 09 BARRIER  
RWY 27  
(THLD)

**AERODROME REMARKS**-Ldg fees rqr. ①9416' avbl ldg Rwy 27L. ②Reserved for acft of or  
bound for Clermont-Ferrand Air Industry, 2 hr PPR for others.

### COMMUNICATIONS

CLERMONT APP CON-125.0 118.9 290.4

CLERMONT VOLVIC APP CON-362.3 140.4 385.4X 344.0X 340.2② 290.4③ 275.5④ 123.3⑤ (U)

CLERMONT ARPT Tower-122.1 118.5 255.3⑥ (U) CLERMONT GND CON②-257.8 121.7

### RADIO AIDS TO NAVIGATION

VORW CMF 115.7 (60/FL 500) 45°43'10"N 03°07'24"E 027° 4.0 NM to Fld.

NDB (10 NM-W) (A1) CF 368 45°48'16"N 03°21'44"E 266° 7.4 NM to Fld.

NDB (50 NM-W) (A1) CMF 350 45°43'13"N 03°07'18"E 027° 4.0 NM to Fld.

VHF/DF CLERMONT HOMER-362.3 275.5 140.4 122.1 385.4X 344.0X 340.2② 290.4③ 255.3⑤ (U)

UHF O/S UFN.

UHF/VHF/DF CLERMONT VOLVIC-362.3 140.4 122.1 385.4x 344.0x 342.0⑤ 280.9⑥ 251.6⑥ 242.0

(U) UHF O/S UFN.

④ ILS-BRG 266° LCZR 109.5/332.6 Glide Slope 2.9°. BC unuse. Usable sctr 88°. IMC, OT O/R to  
twr.

■ **RADAR**②-ASR/PAR Call CLERMONT VOLVIC APP CON.

**RADIO/NAV REMARKS**-②Special freq. on instr. ③Special freq. ④On instr. ⑤Gnd ttc exc rwy.

⑥0700-1600Z Mon-Fri, exc hol. OT PPR fr the Mil Flt OPS Ctl Cntr prior 1000Z prev workday.

MP 0700-1100Z ev Thu exc 1st Thu of month when MP is 0700-1600Z. Ltd restriction to 1.1 NM  
and 350' fr thld.

## 54 AERODROME/FACILITY DIRECTORY

**Δ-RAMSTEIN AB, (LANDSTUHL) GERMANY (Landstuhl) 49°26'N 07°36'E**

(AOE) GMT+1

**H-3C-6G, L-6F**

AF 782 BL6, 7①, 8 (Rwy 09-27), 9 H80② (ASP) (S71, T187, ST175, TT325, TDT800)

(EDAR)

JASU- (MD-3) (MA-1A) 5(MA-2) (M-32)

FUEL A+J4, SP, De-Ice, ADI, O-128-133-148 SOAP PRESAIR LHOX LOX

A-GEAR

RWY 09 MA-1A MOD BAK-9(B)①④ BAK-13(B)①

(226' OVRN)

(789')

(2098')

(1894')

BAK-13(B)①

(796')

BAK-9(B)①④

MA-1A MOD

RWY 27

(226' OVRN)

**EXPLOSIVES CAPABILITY- A/2/29/58/50-8/40/80/350 PPR 5313/5314**

**AERODROME REMARKS-** Mandatory NOISE ABATEMENT PRO: Essential flt of and ldg 2100-0500Z dly and not before 1200Z Sun and German hol. Tran act must arr and dep IFR and lfd to one apch. If not IFR eqpt/rated, ctc RAPCON on 138.9 or 323.0 for instr at least 30 NM out. Unless otherwise instr, flw Ramstein TCA to alt inbd rte (FLIP AP/2). Avoid Ramstein village 1 NM NW. VFR only copter flw FLIP VFR ARR/DEP RET Europe. CAUTION- lnts copter trng 600' S of rwy. Lcl VFR act enter ttc pat N of cil zone at 3000' MSL, initial 2500'. CAUTION- Severe FOD problem on Aerial Port ramp and adjacent ttry to Rwy 09. To prevent foreign object damage while taxiing, unless operationally req, use inboard eng only and do not use reverse thrust or abv idle. CAUTION- Unct vehicles on ramps and ttry. 9 lgtd ttr btn 80' and 165' lctd 1000' to 2000' N of dep end Rwy 27. Rwy has porous friction sfc 180° turns permitted only on concrete portions on apch ends. Reduced rwy separation std of 4000' in use btm similar performance act (closely related in size, speed and opr characteristics) (except heavyweights). VASI Rwy 27, TD pt 150' fr thld, 500' prior to PAR TD pt 891' prior to ILS GPI. GS 2.8° not coincidental with PAR GP within 2 NM of thld, pilot will rcv fly down on PAR GP. VASI TCH 7.6'. VASI Rwy 09, TD pt 650' thld, coincidental with PAR TD pt. GS 2.5° TCH 28.4'. ① Apch lgt system begins 2417' prior to thld. White roll bar lgt of Rwy 19 apch lgt system out for 90 day test til 7 Sep 77. CAUTION-UFN numerous apch lgt to Rwy 27 misaligned. Lgt appear to be out until drct overhead. New system to be installed in 1978. ②First 796' Rwy 27 and 789' Rwy 09 is concrete. ③Arresting cable 3" above rwy sfc. ④Apch ends connected and rigged for no-rtc engagement only when BAK-13 is O/S.

**COMMUNICATIONS (SFA) (PTD 367.6)**

\* RAMSTEIN APP CON-247.5 277.21 138.9 (E)

TOWER-337.0 257.8 123.55 (E)

GND CON (CLNC DEL)-375.0

RAMSTEIN DEP CON-242.3 138.9 (E)

MAC AIRLIFT-279.0

WING COMMAND POST-375.5 (262.4) phone patch capability. CS: TOON CONTROL

STAGE 1 RADAR SVC-Ctc APP CON 25 NM out on 247.5

PMBV: METRO-379.0 Full svc.

**RADIO AIDS TO NAVIGATION**

TACAN RMS Chan 81 (80/50) 49°26'08"N 07°35'34"E At Fid. 071° 11.5 NM to Sembach AB. MP

0430-0600Z Tues, if ASR is opr.

TACAN unuse

110°-190° 10-30 NM blw 10,000' & byd 30 NM blw 12,000'

190°-220° byd 20 NM blw 8000'

220°-110° byd 15 NM blw 6000'

Exc on publ Apch & SID.

ILS-MP 0700-1100Z Thu and 1300-1500Z Fri.

**RADAR-SEE TERMINAL FLIP FOR RADAR MINIMA.**

**RADIO/NAV REMARKS-①IFF/SIF-Ctc RAPCON on 247.5 242.3 or 133.9 for lfd ct.**

**REIMS/PRUNAY, FRANCE 49°13'N 04°09'E GMT+1(+2DT)**

**L-6E-7D**

CIV 312 H38① (ASP) (566, T105)

(LFGA)

FUEL①-(NC-A1)

**AERODROME REMARKS-** Opr 0800-1130Z, 1300-1630Z Mon-Fri; Sun & hol svc not assured.

CSTMS O/R 24 hr 0730-1130Z, 1300-1630Z. ①3100' avbl ldg Rwy 07. 2756' avbl ldg Rwy 25.

②0730-1130Z, 1230Z to 55-30 Mon-Fri, 0730-1100Z, 1300Z to 55-30 Sat, Sun & hol.

VHF/DF REIMS HOMER-118.0

**RHEIN UAC/MUAC (EUROCONTROL UAC), GERMANY**

**H-3-B**

**RADAR/CONTROL**

(EDGU)

CIV-384.3x 377.3 357.9x 353.8① 312.8 276.8 255.5 244.7 242.1 238.4x 229.2 135.95x 134.95 134.8

134.55 133.65 133.275x 132.775x 132.725x 132.325x 132.4 132.15 129.85① (E)

MIL-395.8 327.6

FRANKFURT SECTOR-373.0x 275.6①

FULDA SECTOR-277.7① 395.8x

MATTENHEIM SECTOR-298.7① 346.5x

BOLLINGEN SECTOR-325.1① 337.7x

TANGO SECTOR-394.4① 399.2x

MONITOR-321.0① 310.0②

UHF/VHF/DF-O/R Call Radar

REMARKS-①Mil grd for all svc ②Mon-Fri 0630-2130ZOT O/R ③(ED)TRA 204 and 304. ④

(ED)TRA 205, 305A and 305B.